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III. *An Account of some Peculiarities in the Structure of the Organ of Hearing in the Balæna Mysticetus of Linnæus. By Everard Home, Esq. F. R. S.*

Read December 12, 1811.

IN the year 1799, I laid before the Society some observations on the Structure of the Membrana Tympani, in consequence of having found that in the elephant that membrane has a muscular structure.

In the elephant the membrana tympani has a greater breadth than in any other animal I have had an opportunity of examining; the structure of its different parts is therefore rendered more conspicuous, which enabled me to discover the muscular fibres.

With a view to prosecute this inquiry, I have ever since that time been desirous of an opportunity of examining the membrana tympani in the balæna mysticetus, having no doubt of its being of such extent as to shew the structure to advantage; and by the kind attention of Mr. SCORESBY, Jun. of Whitby, I have now succeeded: that gentleman in his last voyage in the Greenland whale fishery, procured for me the cranium of a cub of the balæna mysticetus whose extreme length was from sixteen to seventeen feet, and its circumference from twelve to thirteen feet. This cranium was put into a cask of salt water, and arrived in London in good condition, the different parts of the organ of hearing being in a state fitted for dissection.

In my examination of the organ of hearing in this young whale, I find there is a peculiarity in its mechanism not met with in the smaller species of whale, and to which there is nothing similar in other animals. As this very singular mechanism is not noticed by either CAMPER or MONRO, and is only glanced at by HUNTER, to whom it was imperfectly known, I shall give a description of it, and in doing so, mention the other parts of the organ, so far as will be necessary to make myself understood.

The cranium had been deprived of the external skin, consequently the outward aperture of the ear had been removed; a very small portion, however, of the external meatus could have been cut off, since the dark coloured cuticular lining, which is a continuation of the outward covering of the head, extended a little way into the tube.

The meatus externus was five inches and a half long, and probably an inch had been cut off. Near this part the tube was one quarter of an inch in diameter, in the middle it was narrower, and near the membrana tympani one inch and one-third of an inch.

By comparing the measurement of the length of the tube with that of the skull in this whale, and with the large skull in the Hunterian Museum, the meatus externus in the full grown whale will be found to be about two feet six inches in length.

The membrana tympani is one inch and one-tenth of an inch in diameter, where it is attached to the bone; instead of being concave, as in other animals, towards the meatus externus, it is convex, and projects nearly an inch into that tube. Its external surface is composed of a smooth firm cuticular

covering which readily separates as soon as putrefaction comes on; under this is a strong compact membrane, and when that is removed there is a regular layer of muscular fibres; these go over the whole of the embossed part, having their origin at the edge of the bone to which the membrane is attached, and terminating in the bone on the opposite side. This arrangement of muscular fibres, differs from that of the elephant, where the central part is tendinous. The muscular fibres have a membranous lining between them and the cavity of the tympanum.

From this description of the membrana tympani, it is evident that there is no connexion between it and the ossicula auditûs, or small bones of the ear, which Mr. HUNTER supposed to be the case in consequence of having found that it was so in the porpoise.* He says, “in the piked whale the membrana tympani is projecting, and returns back into the meatus externus for above an inch in length, is firm in texture, with thick coats, is hollow on the inside, and its mouth communicating with the tympanum, one side being fixed to the malleus, similar to the tendinous process which goes from the inside of the membrana tympani in the others.”

The fact is, that there is no connexion whatever between the membrana tympani and the malleus, as will be explained; but as that circumstance forms the great peculiarity in the organ of this species of whale, I thought it right to quote what he had stated on this subject.

Having pointed out that there is no direct connexion between the membrana tympani and the ossicula auditûs, as in

* Observations on the Structure and Œconomy of Whales. Phil. Trans. Vol. LXXVII. p. 371.

other animals, and also shewn that HUNTER, unwilling to believe that there could be so great a deviation from the ordinary construction of this organ, was led into an error, which I can only attribute to his having formed to himself too strong a chain of analogies, I shall proceed in my description of the organ.

Immediately behind the membrana tympani is a large cavity formed principally by the concave surface of a large hard bone peculiar to the whale, in the substance of which there is more earthy matter than in almost any other bone met with in animal bodies. In its form it is not very unlike the shell called the concha Veneris, to which it has been compared.

The cavity of the tympanum is of an oval shape, one end of which is bounded by the membrana tympani, the other forms the entrance of the Eustachian tube, and there the cavity is surrounded wholly by membrane inclosed in the substance of the skull. The large concave bone is only slightly connected with the petrous portion of the temporal bone, and is imbedded in a fatty substance of nearly an inch in thickness, with a smooth external surface.

The Eustachian tube is two inches and a half long, it opens externally into the canal leading to the blow-hole; its internal surface is honey-combed, which gives it a glandular appearance, and there are chords and septa crossing from side to side in different places: where it opens into the cavity, it has a valvular structure. The cavity, as it corresponds in its principal uses with the tympanum of other animals, although it does not, as in them, contain the ossicula auditûs, deserves to be called by the same name; it is equal in size to a pint measure, and can only be filled from the Eustachian tube, there being

no other opening into it by which it can communicate externally.

Within the cavity of the tympanum, close to the bony rim to which the membrana tympani is attached, there is a membranous fold fixed at one end to the centre of a slight protuberance on the concave surface of the large hollow bone, and stretched across the cavity, its loose upper edge forming a line across the centre of the hollow of the membrana tympani, the other end passing beyond the cavity to be attached to the short handle of the malleus, which is situated immediately behind the membranous lining of the tympanum. The long handle of the malleus is left loose. The incus and stapes have the same relative situation to one another as in the human ear, differing in nothing but being contained in a cavity distinct from that of the tympanum. The appearance of an os orbiculare is wanting.

The other parts of the organ, the vestibulum, semi-circular canals and cochlea, and the meatus internus through which the nerves from the brain pass to be distributed to these parts, do not differ materially from what is met with in the human ear. As the parts which have been described are delineated in the annexed drawings, I have been less minute in my description than I should have otherwise thought it necessary to be.

From the mechanism which has been described, it is evident that the impulses made on the membrana tympani are not immediately communicated to the ossicula auditûs as in other animals; they are only communicated to the tympanum and thence to the chord stretched across its cavity.

The membrana tympani by its muscular structure has the means within itself of adjustment to different sounds, while

the animal is under water; but the degree of pressure to which it is liable, is incompatible with the nicer vibrations required to impress the internal organ so as to convey to it distinct sounds, and it is for this last purpose that the membrane is stretched across the cavity of the tympanum.

This membrane, from being connected with the concave bone, will have its vibrations increased, and the bone being imbedded in a fatty covering, none of the vibratory motion impressed upon it can be carried off from the opposite side, but the whole will be communicated to the malleus, and so on to the cochlea and semi-circular canals.

EXPLANATION OF THE PLATES,

PLATE I.

An external view of the parts in which the organ of hearing is contained.

aa. The external surface of the large concave bone which forms the cavity of the tympanum.

b. The petrous portion of bone, in which the cochlea and semi-circular canal are contained.

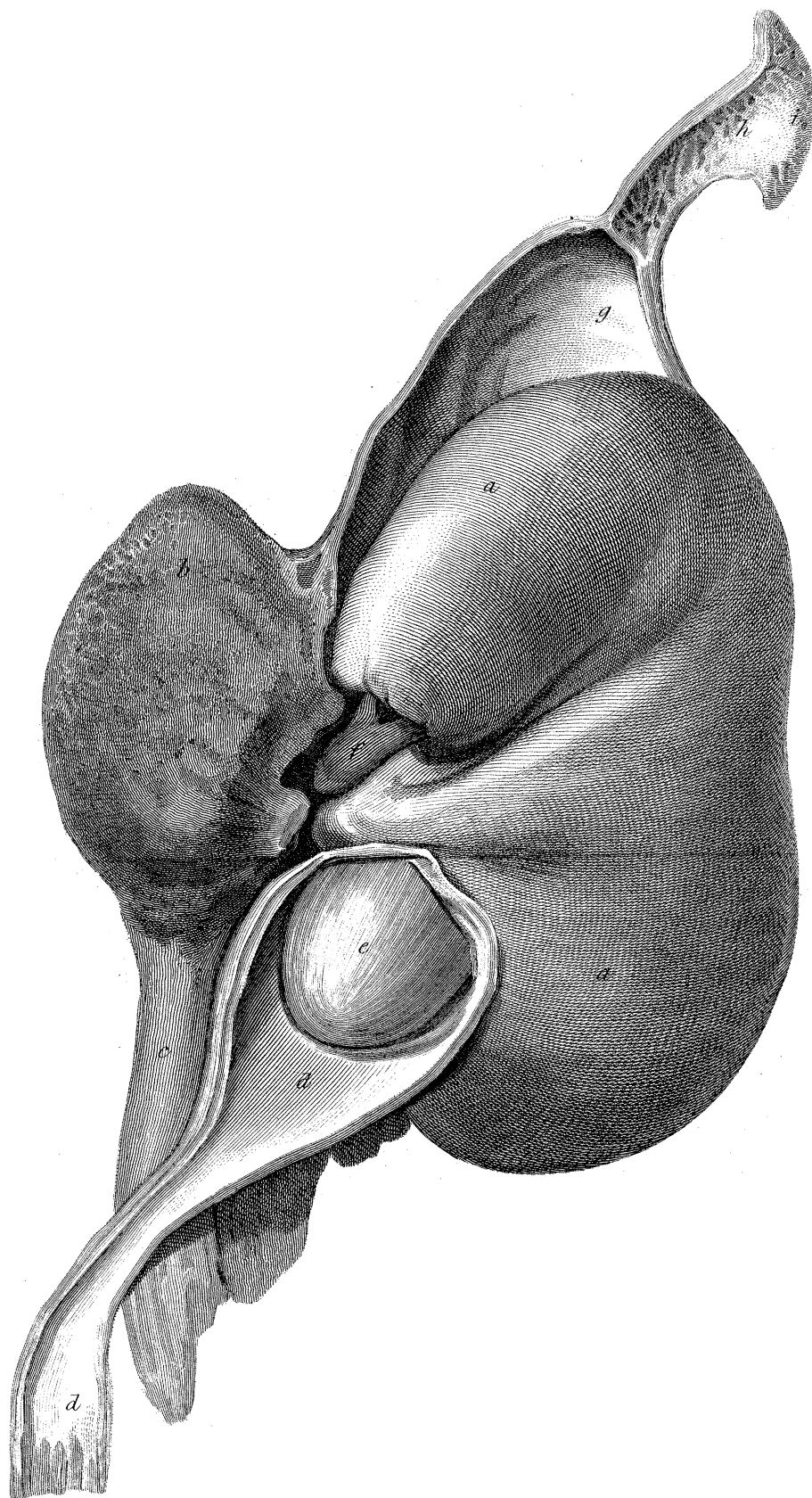
c. A bony process connecting the petrous portion with the skull.

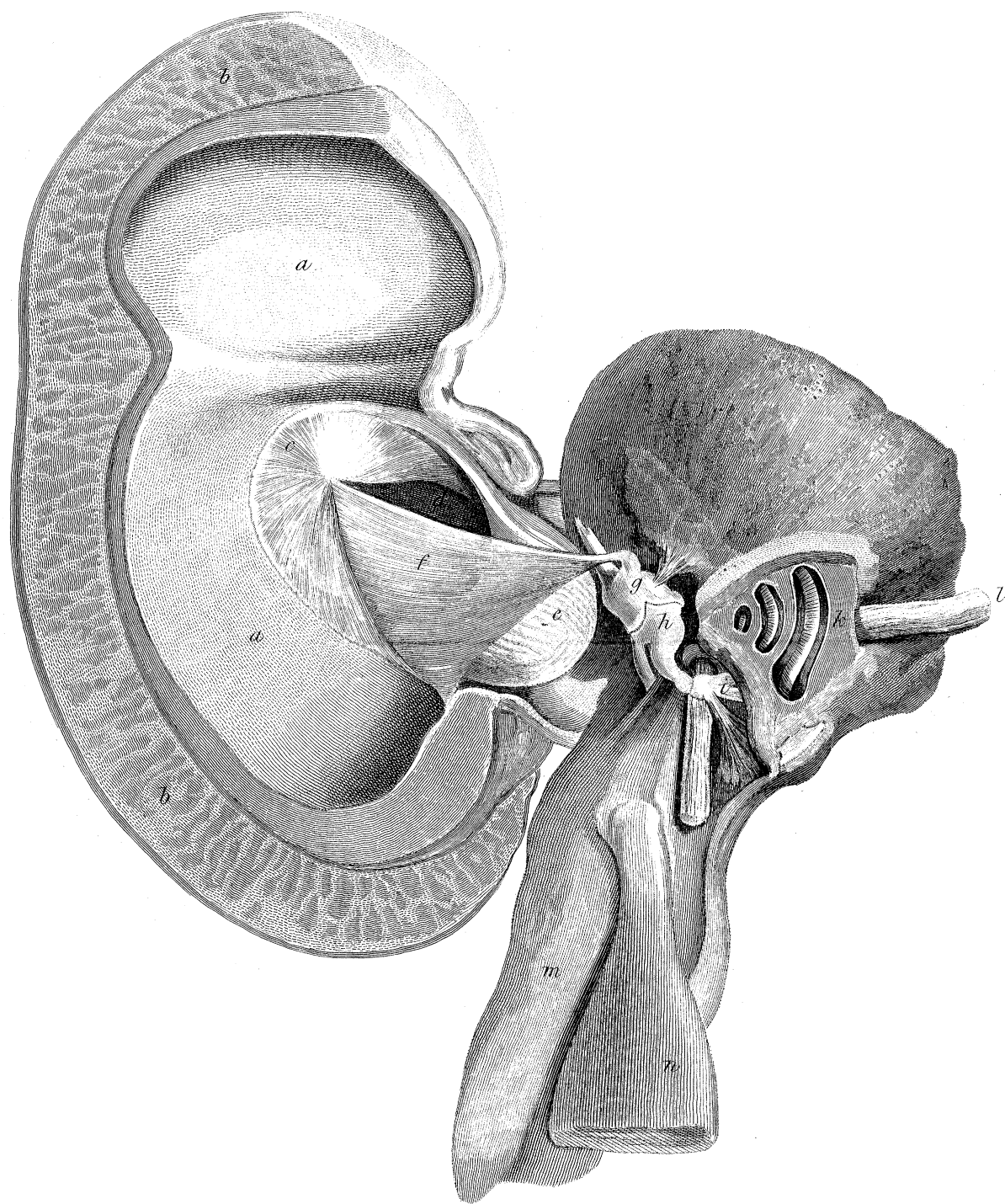
dd. The meatus auditorius externus.

e. The surface of the membrana tympani to show its muscular fibres, the external covering having been removed.

f. A portion of the malleus, one of the small bones of the ear.

g. The anterior portion of the cavity of the tympanum





which extends beyond the concave bone, laid open to show the termination of the Eustachian tube.

h. The internal surface of the Eustachian tube.

i. The opening of the Eustachian tube into the nostril.

PLATE II.

aa. The internal surface of the concave bone.

bb. The fatty case in which it is inclosed.

c. A convexity covered by a thin ligamentous periosteum, whose fibres are radiated and connect the membrana tympani, as well as the membranous fold *f*, to the bone.

d. The hollow formed on the inside of the membrana tympani.

e. The external surface of the membrana tympani.

f. The membrane stretched across from the concave bone to the malleus.

g. Malleus.

h. Incus.

i. Stapes.

k. Cochlea.

l. Auditory nerve.

m. The bone connecting the petrous portion to the skull.

n. A cartilage which had been cut through in preparing the cranium; the part with which the other extremity was connected has not been ascertained.